Chapter 8
WATER SOURCE OPTIONS

Water source options are defined as options that make additional water available from existing or new sources, such as wellfield expansion and wastewater reuse, or options that reduce water use, such as increased irrigation efficiency or water conservation. Other options are presented to offer management techniques, such utility interconnects or ASR, which look to manage either the demand or source of water to minimize potential impacts. This chapter discusses these options. Water conservation is another water supply/demand management option, but is given a separate detailed discussion in Chapter 7.

GROUND WATER

For existing uses where ground water is primary source, the development of additional ground water is usually the least cost and preferred option. This fact, along with the historic precedent of the use of ground water, has made the choice of expanding fresh ground water the primary identified future option for nearly every utility and agricultural user located within the Kissimmee Basin (KB) Planning Area. Although all of the potable aquifers within the basin are utilized to some extent, the surficial and Floridan aquifers are the most frequently used. The surficial aquifer is generally limited to smaller uses such as household or small agricultural uses. This is due to the relatively small well yields. One notable exception is Okeechobee Utilities which withdraws an estimated 1.0 MGD from the surficial and intermediate aquifers. In some areas, horizontal well technologies may be implemented to obtain higher yields from the Surficial Aquifer System (SAS), but these type wells are generally limited to specific applications due to the potential of the water table lowering and causing wetland harm. With the exception of Okeechobee Utilities, nearly all other ground water use within the planning basin comes from the fresh water portion of the Floridan Aquifer System (FAS).

Cost estimates associated with these two source alternatives have been broken into construction and capital costs and production costs. An example of the costs associated with expanding fresh ground water use in the KB Planning Area is given in **Table 27**. Construction and capital costs are those costs associated with the initial installation of the facilities, in this case the wells and pump fixtures only. Other costs related to piping, electrical service, land acquisition, and treatment/storage facilities are not included in the table and could increase the cost of expansion considerably. Estimates are based upon assuming an 8-inch diameter surficial aquifer well with a maximum depth of 200 feet and a 16-inch diameter Floridan well of 900 feet in depth. Operational costs identified are those related to the maintenance of the well and the cost of operation of the well.

Table 27. Well Costs for Aquifer Systems.

Aquifer System	Drilling Cost (per well)	Equipment Cost (per well)	Engineering Cost (per well)	Operations and Maintenance Cost (per 1,000 gallons)	Energy Cost (per 1,000 gallons)
Surficial	$15,000	$6,000	$12,000	$0.004	$0.022
Floridan	$112,500	$50,400	$17,500	$0.004	$0.022

UTILITY INTERCONNECTIONS

Interconnection of treated and/or raw water distribution systems is an option typically limited the purpose of providing backup water service in the event of disruption of a water service. This operation, although currently employed by many utilities, is thought of a means to address local or temporary service shortfalls. Regional implementation of a utility interconnection system could be employed as a demand management tool. The purpose of implementing this alternative would be to shift withdrawals in those areas deemed to be at highest risk of being adversely impacted to areas where the withdrawals are projected to have less impact. This would be completed through bulk purchase of raw or treated water from neighboring utilities in lieu of expanding an existing withdrawal and/or treatment plant. A detailed study of distribution systems proposed for interconnection would need to be made to address system pressures, physical layout of the supply mains, impacts on fire flows and compatibility of the waters, among other items.

The costs associated with wellfield interconnects are difficult to estimate and could vary greatly depending on the size, distance and potential engineering hurdles. Typically, an interconnect system includes the transmission main, pump facilities and storage facilities. An interconnect system may also include an operation and maintenance component for the transmission main and facilities, and energy pumping costs. Cost estimates for this option are provided below (**Table 28**).

Table 28. Utility Interconnect Cost Estimates.

Transmission Line Size	Installation Cost (unit measure)	Engineering Cost (unit measure)	Land Costs $/ft[a]	Easement Costs $/ft[b]
16-inch	$44	$20	$56.25	$37.50
24-inch	$69	$31	$56.25	$37.50
30-inch	$87	$39	$75.00	$50.00

a. Based on suburban land costs- urban or rural costs will vary.
b. Does not include jack and bone, tunnels, or valves.
Source: West Coast Regional Water Supply Authority, 1995.

WASTEWATER REUSE

Reuse is the deliberate application of reclaimed water for a beneficial purpose, in compliance with the FDEP and water management district rules. Reclaimed water is wastewater that has received at least secondary treatment and is reused after flowing out of a wastewater treatment plant (Chapter 62-610, F.A.C.). Potential uses of reclaimed water include landscape and agricultural irrigation, ground water recharge, industrial uses, environmental enhancement and fire protection. Additional discussion of reuse, including reclaimed water regulations and more detailed information on potential uses, is provided in Appendix F. Although the FDEP definition of reuse would include nearly all facilities that do not directly discharge to an open water body, not all reuse is equally effective. The most effective reuse projects are those that apply reclaimed water for irrigation or have infiltration basins located in designated high recharge areas.

Encouragement and promotion of wastewater reuse and water conservation are formal state objectives. The State Water Policy requires the FDEP and water management districts to advocate and direct the reuse of reclaimed water as an integral part of water management programs, rules, and plans. Several regulations also require an evaluation of reuse versus other disposal methods prior to issuance of department permits.

Reuse Costs

The costs associated with implementation of a reuse program vary depending on the size of the reclamation facility, the facility equipment needed, the extent of the reclaimed water transmission system, and the regulatory requirements. Some of the major costs to implement a public access reuse system are as follows:

- Advanced secondary treatment
- Reclaimed water transmission system
- Storage facilities
- Alternate disposal
- Application area modifications

Cost savings include negating the need for or reducing the use of alternative disposal systems, negating the need for an alternate water supply by the end user, and reduction in fertilization costs for the end user.

Existing Treatment Facilities

There are 18 existing regional wastewater treatment facilities in the KB Planning Area. These facilities treated 60.59 MGD of wastewater in 1995. Of this amount, approximately 49 MGD was used for beneficial purposes such as irrigation or percolation ponds in high or moderate recharge (Floridan) areas. The remaining 11.28 MGD went to lower beneficial uses such a surface water discharge or percolation pond in low recharge areas. The use of water that was discharged to surface water or to percolation ponds in low recharge areas could be made available for more beneficial reuse with more strategic planning and the proper infrastructure. The volume of wastewater treated by regional wastewater treatment facilities is projected to increase to about 136 MGD by 2020 with an additional 88 MGD potentially going to higher beneficial purposes. Summarized wastewater facility information is provided in Appendix D.

STORMWATER USE

This option is defined as the collection of stormwater runoff from urban areas and should be distinguished from runoff collection from agricultural land, which is addressed under surface water storage. The stormwater use option is thought to be most applicable to landscape irrigation practices on a localized scale. A common application of stormwater use is the use of urban development ponds to supplement golf course irrigation demands or entry way landscaping. The costs associated with these types of uses are considered to be nominally above those for the ground water alternative that it would replace.

SURFACE WATER STORAGE

This option involves the capture and storage of excess surface water during rainy periods and subsequent release during drier periods for environmental and human uses. The capture of excess surface water runoff and ground water seepage from canals and rivers, and storage of these waters in existing or new surface water reservoirs or impoundments, provides an opportunity to increase the supply of fresh water during subsequent dry periods. The primary problems associated with surface water storage are the expense of constructing and operating large capacity pumping facilities, the cost of land acquisition, appropriate treatment costs, the availability of suitable locations, and the high evaporation rates of surface water bodies.

Costs associated with surface water storage vary depending on site-specific conditions of each reservoir. A site located near an existing waterway will increase the flexibility of design and management and reduce costs associated with water transmission infrastructure. Another factor related to cost would be the existing elevation of the site. Lower site elevations would allow for maximum storage for the facility while reducing costs associated with water transmission and construction excavation. Depth of the reservoir will have a large impact on the costs associated with construction. Deeper reservoirs result in higher levee elevations, which can significantly increase construction costs.

Costs associated with two types of reservoirs are depicted in **Table 29**. The first is a minor facility with pumping inflow structures and levees designed to handle a maximum water depth of 4 feet. It also has internal levees and infrastructure to control internal flows and discharges. The second type shown below is a major facility with similar infrastructure as the minor facility. However, the water design depths for this facility range from 10 to 12 feet. Costs increase significantly for construction of higher levees but can be offset somewhat by the reduced land requirements.

Table 29. Surface Water Storage Costs.

Reservoir Type	Construction Cost $/Acre	Engineering/ Design Cost $/Acre	Construction Administration $/Acre	Land $/Acre	Operations and Maintenance Cost $/Acre
Minor Reservoir	2,842	402	318	4,500	118
Major Reservoir	7,980	904	451	4,500	105

Costs for the minor reservoir are based on actual construction bid estimates received and awarded for similar projects currently being built in the Everglades Agricultural Area (EAA). Costs of these four Stormwater Treatment Areas (STAs) were averaged to develop the $/acre construction and operation costs. Costs for the major reservoir were developed based on the average cost estimates from the proposed Ten Mile Creek project (in St. Lucie County) and from the Regional Attenuation Facility Task Force Final Report, April 1997 estimates for major Water Preserve Areas.

AQUIFER STORAGE AND RECOVERY

Aquifer storage and recovery (ASR) is defined as the underground storage of injected water in an acceptable aquifer during times when water is available, and the subsequent recovery of this water when it is needed. Simply stated, the aquifer acts as an underground reservoir for the injected water, reducing the water loss to evaporation. Sources of injection water could include treated and untreated ground and surface water, and reclaimed water.

Because of limited water resources, increasing demands, and more stringent water quality standards, ASR technology is receiving growing attention. The regulatory criteria for ASR permitting is discussed in KB Water Supply Plan Appendices.

ASR Costs

Estimated project costs for ASR consisting of a 900-foot, 16-inch well, with two monitoring wells using treated water are shown in **Table 30**. One system uses pressurized water from a utility; whereas the second ASR system uses unpressurized treated water, thus requiring pumping equipment as part of the system cost. However, utilities implementing ASR systems may incur additional costs for surface facilities, such as piping, storage, and rechlorination. Other available data indicate that typical unit costs for water utility ASR systems now in operation tend to range from $200,000 to $600,000 per MGD of recovery capacity (CH2M Hill, 1993). At the same annual recovery rate used above (100 days at the daily recovery capacity), the costs per thousand gallons recovered would be $.30 to $.70 per thousand gallons. These systems have well capacities from

0.3 to 3 MGD and store treated water. Savings in treatment system costs are likely to be substantial when the ASR system offsets the need for additional treatment capacity to meet peaks in demands.

Table 30. Aquifer Storage and Recovery System Costs.

System	Well Drilling Cost (per well)	Equipment Cost (per well)	Engineering Cost[a] (per well)	Operations and Maintenance Cost (per 1,000 gallons)	Energy Cost (per 1,000 gallons)
Treated Water at System Pressure	$200,000	$30,000	$360,000	$.004	$.06
Treated Water Requiring Pumping	$200,000	$100,000	$400,000	$.006	$.06

a. Engineering costs include the permitting process, hydrogeologic investigation, monitoring during well construction, and design.

Source: PBS&J, 1991, Water Supply Cost Estimates.

Existing ASR Facilities

ASR facilities are already in operation in New Jersey, Nevada, California, and Florida. Five operational facilities exist in Florida: Manatee County (1983), Peace River (1984), Cocoa (1987), Port Malabar (1989), and Boynton Beach (1993). These facilities all use treated water and are further discussed in KB Water Supply Plan Appendices. There are ASR development studies currently underway in Washington, Utah, Arizona, Georgia, South Carolina, Texas, and Virginia. More recently ASR has been proposed as part of the Central and South Florida Restudy project as a means of adding storage of water associated with Lake Okeechobee. The recommendation proposes locations of wells north of the Lake Okeechobee in the KB Planning Area.

DRAINAGE WELLS

Although technically drainage wells are injection wells and are regulated under the same guidelines as ASR wells, the function and costs associated with these wells is different. Like ASR wells, drainage wells function is to store surface water that is captured in the underground aquifer system. Unlike ASR wells, however, there is no extraction operation associated with these wells. The storage function is in the form of aquifer recharge which in turn can be withdrawn from multiple wells operating in the region.

The metro-Orlando area is the only location in the planning region where drainage wells exist. There are an estimated 350 to 400 wells that are known. The majority of these wells were installed 30 to 40 years ago to assist in controlling lake levels. The wells generally receive storm water discharged to lakes, but there are wells that take water directly in from street runoff. Street runoff is a potential source of contamination to the aquifer system. It is estimated that as much as 20 inches a year of recharge may be due to drainage wells in the Orlando area.

The costs associated with drainage wells are similar to those of normal production wells, with the exception that there are no energy costs. In addition, drainage wells into the surficial aquifer are not considered a viable option.

The permitting of these wells is similar to that of ASR wells and requires approval from the FDEP. Recently, however, the potential water quality problems associated with these wells have been brought to the attention of the FDEP. Thus, the number of drainage wells permitted has dropped dramatically. Consideration of this option would include a lengthy permitting effort to document risks associated with direct injection to the fresh water aquifer.

SALTWATER/BRACKISH WATER

Brackish water in the Floridan aquifer exists in the southern portion of the KB Planning Area near the north shore of Lake Okeechobee. This source is relatively untapped in the KB Planning Area. The only other source of brackish water in the region is surface water from the St. Johns River in eastern Orange County, located outside the SFWMD. The use of brackish water for agricultural purposes is limited to chloride values less the 1,000 mg/L and is generally used only for short durations. The use of brackish water for public water supply typically requires the treatment of water by lime softening or reverse osmosis. A disadvantage with lime softening or reverse osmosis treatment is the disposal of brine concentrate from the treatment process. The permitting of such discharge can be a significant hurdle. The costs associated with brackish water treatment are provided in Chapter 9.

FRESH SURFACE WATER USE

Surface water from lakes, rivers and canals is currently used for agricultural irrigation and a minor amount of landscape irrigation. In particular, areas surrounding Lake Istokpoga and Lake Okeechobee in the southern end of the basin use surface water as the primary source for most agriculture, with the exception of citrus. The delivery of water to points of individual withdrawal is controlled by a master system of canals, control gates, and pumps operated by the District. Additional use of surface water delivered by this system may require the installation of new pumps to move water to a new location. Estimates of costs for the installation of these facilities are provided in **Table 31**. For the purposes of the estimate, a pump rated at 60,000 GPM is assumed.

Table 31. Pump Installation and Operating Costs.

Pump Type	Engineering/ Design Cost	Construction Costs	Operation and Maintenance Cost
Electric	$50,000	3-4 million[a]	$60 /hr
Diesel	$50,000	$1.5-3 million	$40 /hr

a. Does not include cost of installing electrical power to site.